

CLAIMS

1. Purification process of nanotubes characterized in that it comprises at least the following steps.
 - solubilization of the nanotubes (p-NT) through their organic functionalization, in which the functionalization reaction is obtained on the nanotubes with 1,3-dipolar reaction of azomethine ylides and separation from metal contaminants,
 - purification from carbon contaminants of functionalized nanotubes (f-NT) obtained in the previous step by precipitation with solvents from their organic solutions,
 - heat treatment of functionalized nanotubes obtained in the previous step to regenerate the initial non-functionalized carbon nanotubes free from traces of metal and carbon contaminants.
2. Purification process of nanotubes as claimed in claim 1 wherein the nanotubes are functionalized through a 1,3-dipolar reaction with:
 - a) compounds with a general formula 1
$$R'-NH-CHR''-COOR''' \quad 1$$
where R' , R'' and R''' equal to or different from one another may be H or alkyl groups with the formula C_nH_{2n+1} with n between 1 and 20, or an aromatic group, or limited to R' , R''' an ether group with the formula $(CH_2CH_2O)_n$ with n between 1 and 20 and
 - b) compounds with a general formula 2
$$R'''-CHO \quad 2$$
where R''' may be H or an alkyl group with the formula C_nH_{2n+1} with n between 1 and 20, or an ether group with the formula $(CH_2CH_2O)_n$ with n between 1 and 20, or an aromatic group.
3. Purification process of nanotubes as claimed in claim 2 wherein the 1,3-dipolar reaction is conducted in dipolar aprotic solvent chosen from the group constituted by dimethylformamide (DMF), dimethylsulphoxide, sulpholane, orthodichlorobenzene with reagents in excess and temperature over 100°C for at least 24 hours.
4. Purification process of nanotubes as claimed in claim 1 wherein the separation from metal contaminants is obtained with mechanical means chosen

from filtration and centrifugation of the organic solution deriving from the functionalization reaction of raw nanotubes.

5. Purification process of nanotubes as claimed in claim 1 wherein purification from carbon contaminants is obtained starting out with an organic solution containing functionalized nanotubes in polar or apolar solvents, chosen from the group constituted by methylene chloride and chloroform, by precipitation with one or more treatments with polar or apolar solvents, chosen from the group constituted by diethylether, petroleum ether, alkanes, alcohols and separation with mechanical means chosen from centrifugation and filtration.
- 10 6. Purification process of nanotubes as claimed in claim 1 wherein the initial nanotubes are obtained by dry heating the functionalized nanotubes in an atmosphere with air or inert gases at temperatures ranging from 250° to 350°C for times between 1 minute and one hour.
- 15 7. Purification process of nanotubes as claimed in claim 6 wherein the heat treatment is performed under vacuum.
8. Purification process of nanotubes as claimed in claim 6 wherein the initial nanotubes defunctionalized by heat treatment are separated with mechanical means chosen from centrifugation and filtration of their suspensions obtained by sonication in polar or apolar organic solvents chosen from the group constituted by dichloromethane, chloroform, toluene.
- 20 9. Functionalized nanotubes obtained with 1,3-dipolar reaction with the nanotubes and:

- a) compounds with a general formula 1



- 25 where R', R'' and R''' equal to or different from one another may be H or alkyl groups with the formula C_nH_{2n+1} with n between 1 and 20, or an aromatic group, or limited to R', R''' an ether group with the formula $(CH_2CH_2O)_n$ with n between 1 and 20 and

- b) compounds with a general formula 2



where R^{'''} may be H or an alkyl group with the formula C_nH_{2n+1} with n between 1 and 20, or an ether group with the formula (CH₂CH₂O)_n with n between 1 and 20, or an aromatic group

except for compounds in which: R'; R", R^{'''} and R^{''''} are equal to one another and

5 equal to H; R' is equal to an ether group with the formula -(CH₂CH₂O)₃-CH₃ and R", R^{'''} and R^{''''} are equal to one another and equal to H; R' is equal to an alkyl group with the formula -CH₂(CH₂)₆CH₃ and R", R^{'''} and R^{''''} are equal to one another and equal to H; R' is equal to an ether group with the formula -(CH₂CH₂O)₃-CH₃, R", R^{'''} are equal to each other and equal to H and R^{''''} is

10 equal to -phenyl-OCH₃; R' is equal to an ether group with the formula -(CH₂CH₂O)₃-CH₃, R", R^{'''} are equal to each other and equal to H and R^{''''} is equal to a pyrene group.

10. Functionalized nanotubes obtained with 1,3-dipolar reaction as claimed 9 in which said reaction is conducted in a dipolar aprotic solvent chosen from the group

15 constituted by dimethylformamide (DMF), dimethylsulphoxide, sulpholane, orthodichlorobenzene with reagents in excess and temperature over 100°C for at least 24 hours.